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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Paper Board Manufacture
Machinery Lubrication

Petroleum Lubricants in
Hydraulic Coupling Operation

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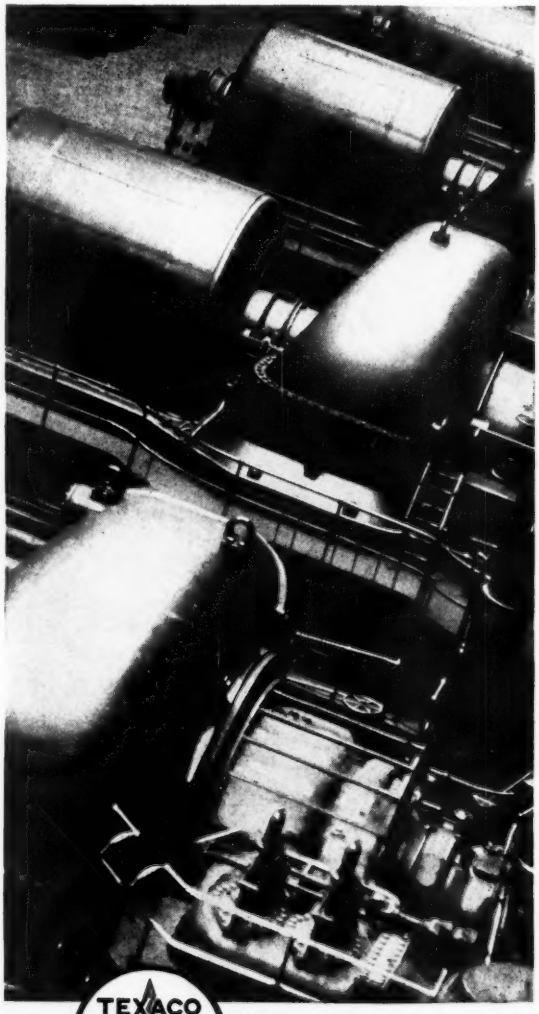

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Paper Board Manufacture

Machinery Lubrication

THE manufacture of boxboard and the subsequent handling of the finished product in the formation of containers has developed into a most flourishing industry with the popularity of this type of container. It has not only furnished an attractive outlet for wood pulp consumption but also has enabled the packaging of foodstuffs, beverages, etc., with speed and economy and eliminated the otherwise necessary return of the containers.

The adaptability of the paper machine of the cylinder mould type to production of the heavy stock suitable for the ply-work necessary in the manufacture of the finished board, has been a considerable factor in this development. The subsequent processes whereby the board sheets are built-up to the specified thicknesses and then cut, printed, folded and stitched to form the finished packages, have also contributed to low cost mass production of this type of container.

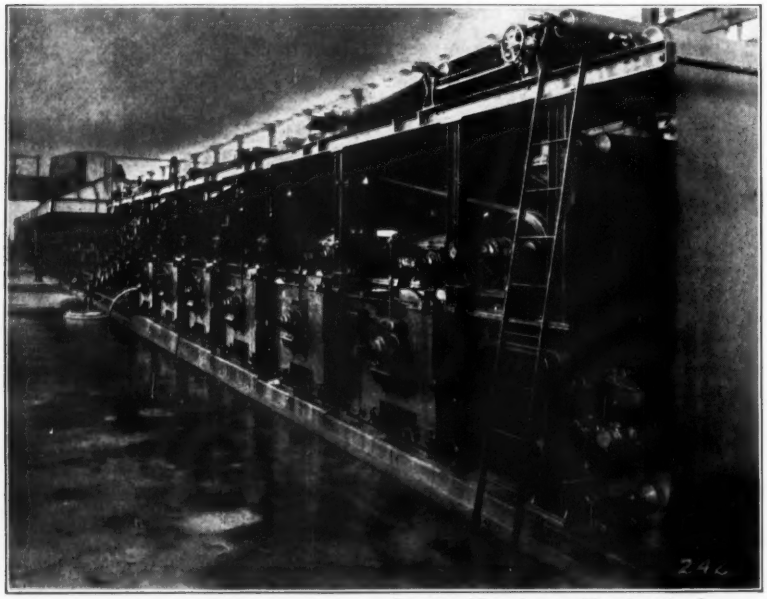
Preparation of the raw stock or pulp for handling on the wet end of the cylinder mould machine is very much the same as preparation of the stock in the more conventional type of paper mill, although some manufacturers will, of course, vary their procedure according to the source of their supply, the design of their paper machine and production requirements.

Paper stock preparation is carried out in the beater, where the necessary degree of hydration is developed. Pulp as it comes from the screens, thickeners or other "wet machines" is usually only one of the ingredients of paper stock; as a rule it must be finished by addition of certain other materials such as clay, talc, alum or perhaps sizing before it is ready for final treatment in the jordan. The beater serves to mix these constituents according to plant requirements. This machine also cuts the pulp fibres to lengths best suited for interlacing and drawing on the paper machine. Long fibres, of course, insure the greatest strength in the finished product; on the other hand, they must not be too long otherwise they would interfere with operation of the paper machine and proper handling of pulp by the felt. This treatment is accomplished by the beater roll which revolves within the beater chamber. The surface of this roll is fitted with blades so located as to be opposed to a set of similar blades in the concave bed-plate of the beater chamber. The action of these blades reduces the pulp fibres to the desired length.

Roll Bearing Lubrication

The beater roll is a comparatively heavy unit, so oftentimes the lubrication of its supporting bearings may present an aggravating lubrication problem. Furthermore, not only must load be considered, but also the detrimental effect of water and pulp on the lubricating film. The use of suitable shock absorbers and automatic means of lubrication, such as the wick oiler, will obviate the above to a large extent and minimize the detrimental results which would otherwise occur. When such con-

struction prevails careful attention must be given to the choice of the lubricant. Normally a 500-second viscosity straight mineral oil will meet the requirements if bearings are properly aligned and no excessive clearance prevails.



Courtesy of Downingtown Manufacturing Company

Fig. 1—Showing the vat end of a six-cylinder Downingtown paper board machine. This unit is equipped with Anti-Friction bearings throughout.

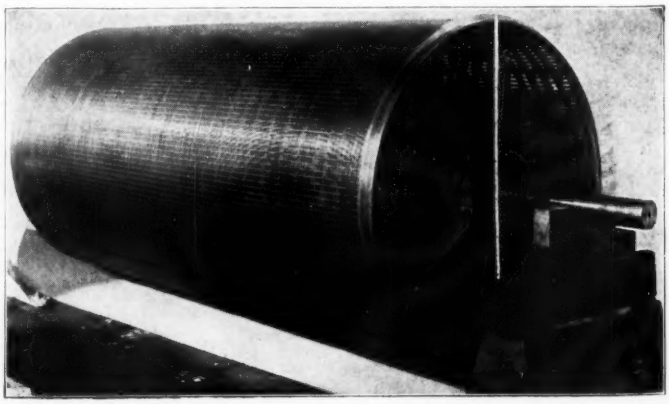
Should wear have occurred, however, to increase this latter it will be well to consider increasing the viscosity. Sometimes a light steam cylinder oil will have to be used for this purpose, although if wear has developed to any marked degree it is not always safe to rely on viscosity alone to protect the bearings; readjustments would be the more logical procedure.

Oil lubrication is not always practicable, however. For example, where open half bearings are involved, or where the tops are provided with recesses or pockets for pad lubrication, grease will frequently be preferred. In such instances a comparatively high melting point product should be used, which will not only develop a lubricating film of sufficient pressure-resisting ability, but also withstand any washing-out effect of water. Resistance to breakdown is also very essential.

MANUFACTURE OF THE BOARD

Paper board is "made" on a cylinder mould or vat type of machine. This machine differs from the more conventional type of newsprint or Fourdrinier machine in that the wire mesh which is used as the first step in draining off water from the pulp web, is stretched on a cylindrical framework which rotates in a vat of paper stock. As this hollow cylinder mould revolves the fluid stock of course will tend to flow through the wire mesh, the fineness of this latter, however, prevents complete penetration and a deposit of pulp fibres is accumulated on the wire. The difference in level between the water inside the cylinder and the paper stock in the vat develops a sufficient amount of suction to build a considerable web or film of fibres on the surface of the wire.

When this web has been built up to the desired thickness, it is picked up or transferred to an endless woolen blanket known as a "bottom wet felt," which moves in the same direction as the surface of the cylinder and with which it is squeezed in close contact by a couch roll revolving in the opposite direction to and on top of the cylinder. The couch roll may also be used as the driving medium on some cylinder machines, although it is most general practice to design for driving through the lower first press roll. In addition, some machines may also have provision for driving through some of the other rolls on the wet end.



Courtesy of Downingtown Manufacturing Company

Fig. 2—Showing a Downingtown cylinder mould.

The thickness of board which is to be made controls the number of such couch rolls and cylinders. The normal maximum will be eight of these roll-cylinder combinations, each successive set building up an additional layer of fibres onto the web. The final couch roll in some cyl-

inder machines may be replaced by a "felt drum roll." At this point in the process the wet paper board supported by the bottom felt is brought into contact with a top felt, and between these two it is passed through a series of small rolls sometimes termed primary press rolls, and thence to a set of suction rolls which squeeze out the greater part of the water content. From this point on the web passes through press and dryer rolls, similar to those employed on the newsprint machine.

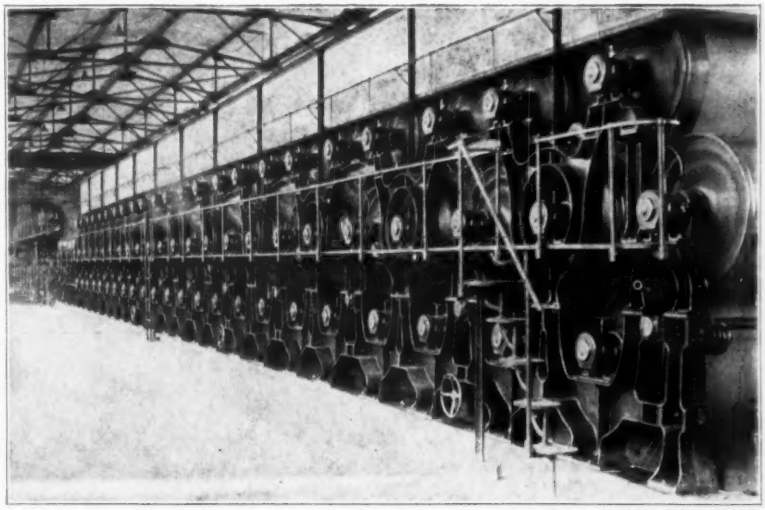
Treatment by the couch rolls renders the web sufficiently tough to resist the effects of tear, so by the time it reaches the press rolls it is capable of supporting itself. Throughout this final pressing operation every care must be exerted to maintain even and continuous pull by the press rolls otherwise the web may tear due to uneven tension. Lubrication of press roll bearings, therefore, becomes of considerable importance to assure of even roll movement; obviously, if a bearing becomes worn or corroded a certain amount of misalignment may develop to materially affect the tension on the paper web as well as the durability of the felt.

Courtesy of Downingtown Manufacturing Company

Fig. 3—The type of Anti-Friction bearing used on the cylinder mould of the Downingtown paper board machine. Note provision for automatic pressure lubrication at the top of the housing.

Couch and Felt Roll Bearings

Felt roll bearings on the cylinder mould machine are chiefly of the plain sleeve type, with the upper half removed, and, therefore, exposed to water. It is the opinion of certain authorities that this condition could be improved by the use of full bearings, equipped for ring-oiled lubrication, or the design of bearing caps of sufficient size to permit application of wool yarn grease in a suitable reservoir.



Courtesy of Beloit Iron Works

Fig. 4—A Beloit three deck dryer section designed for paper board manufacture. Note piping for automatic circulation of oil to each of the dryer bearings.

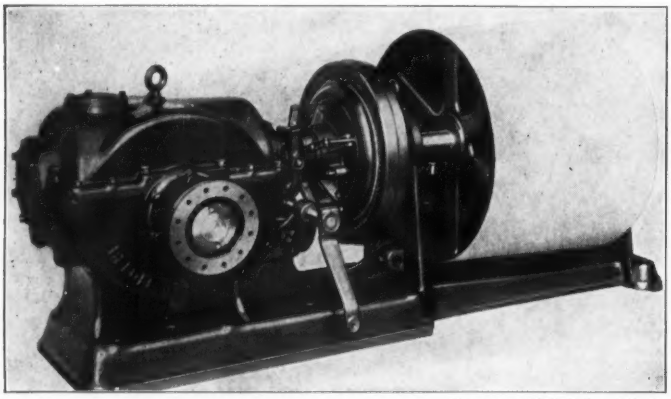
The lubricant to use will, of course, depend upon the construction of the bearings. When these elements have comparatively low clearances and can be regarded as tightly fitting, where automatic means of oiling are employed, a straight mineral oil of about 500 seconds Saybolt at 100 degrees Fahr., should give satisfactory service. In cases where water may gain entry, however, it will be best to use a compounded oil of somewhat higher viscosity which will emulsify on contact with water. Worn or loose fitting bearings or bearings subjected to hand oiling should be similarly considered. In fact, on the latter it may even be necessary to raise the viscosity to that of a medium bodied steam cylinder oil in extreme conditions.

In the study of couch roll bearing lubrication, in turn, it is important to remember that where oil is delivered through the top bearing cap this latter must be properly grooved to permit of adequate circulation of the oil, in order that the existing pressure may be properly counteracted by a positive film of oil, and not allowed to cause actual contact between the roll necks and bearing surfaces.

Press Roll Bearing Lubrication

Three sets of press rolls are used on most cylinder machines. It is frequently customary to drive through the bottom roll; the upper ele-

ments being suitably weighted to enable pressure control according to the amount of dehydration necessary. This matter of pressure, along with the considerable excess of water this emulsifying tendency, will be best. It is important, however, that such a product retain its intended homogenity if it is to function effectively both as a lubricant and as an auxiliary seal to prevent entry of water.



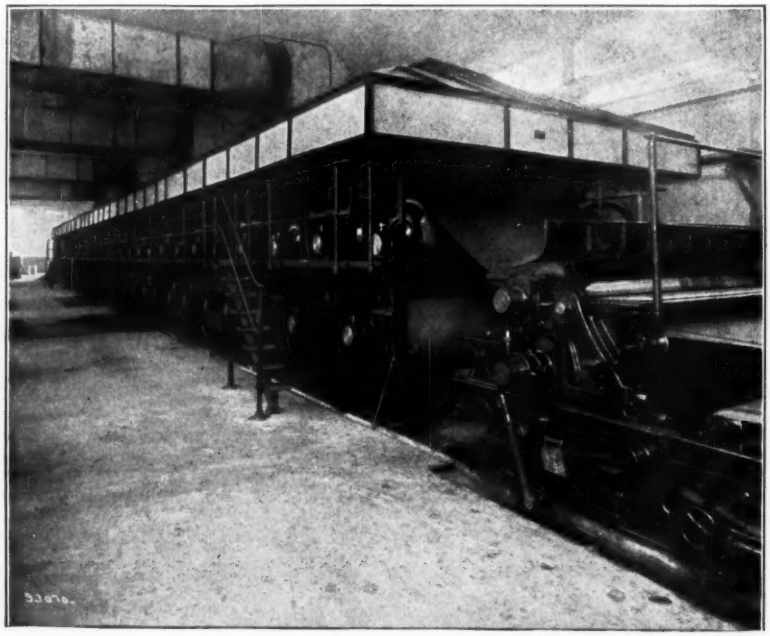
Courtesy of Beloit Iron Works

Fig. 5—Showing the Beloit type hypoid gear unit used as the driving medium on a dryer section. Lubrication of an element of this sort must, of course, be most carefully approached with thorough understanding of the operating conditions and lubricating requirements of the various component parts.

The means of lubricating such bearings will depend on their size. Larger bearings may have to be packed by hand; the caps being periodically removed for this purpose. There is a certain advantage to this procedure in that it affords an opportunity for inspection and estimation of the amount of water leakage which may be taking place. The more usual practice, however, is to use the pressure gun; the bearings being equipped with suitable fittings for gun attachment. This method of lubrication is economical in regard to time and labor. Unfortunately, however, some operators feel that re-lubrication is necessary entirely too frequently. If the seals are in proper condition, the forcing of too much grease into any such bearing may impair the sealing qualities, with resultant leakage. This condition, once started, may become more and more serious, with the result that an excessive amount of grease must be used to maintain positive lubrication.

which may come in contact with the bearings, has called for most careful study of press roll bearing design, the roller bearing receiving special consideration. There is no doubt but that this has contributed markedly toward reductions in the unit cost of lubrication per ton, as well as the cost of upkeep and repair, for such bearings as designed for this service will effectively prevent entry of water and enable the lubricant to resist the prevailing pressures more dependably.

Pressure grease lubrication has, in turn, been studied to the advantage of the operator. Grease is particularly adaptable where the bearing seals can be maintained so as to prevent abnormal contamination of the lubricant and the possibility of rusting or corrosion of the bearing elements. Sealing is aided by the use of a grease of sufficient body to withstand leakage. The relative solubility of any such grease, however, must not be overlooked. Some authorities regard a soluble soda soap product as best suited for such operations in that it will develop a lubricating emulsion to a certain extent in the presence of normal amounts of water. Others feel that a properly compounded lime soap grease, which will resist



Courtesy of Johnson and Wierk

Fig. 6—Showing the cleanly condition of a typical paper board installation where effective lubrication is practiced.

Miscellaneous Roll Operation

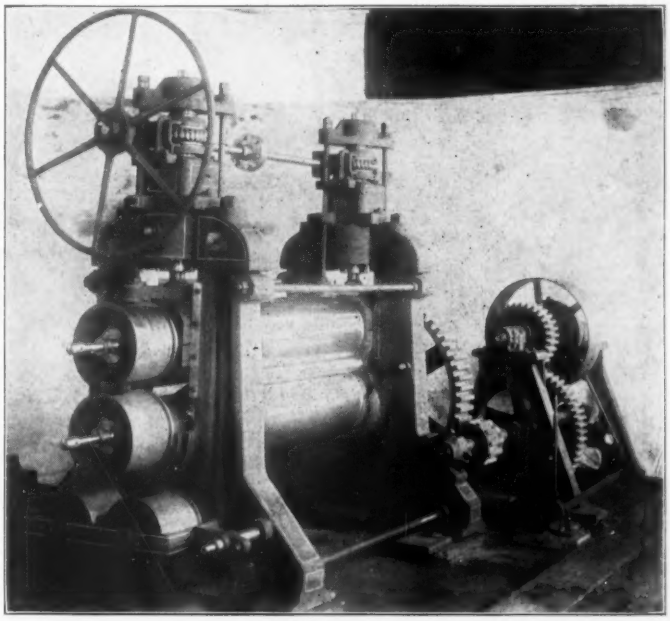
All other rolls must also be given careful

consideration in the general lubrication of the wet end of the cylinder machine. Where plain bearings are involved, grease lubrication has proven to be especially adaptable. On the other hand, regular application of a compounded oil of from 600 to 700 seconds Saybolt at 100 degrees Fahr., is also practicable and cleanly. The purpose of compounding is to enable development of a suitable lubricating emulsion with sufficient adhesiveness to resist water washing.

Smaller roll bearings will usually not be subjected to any abnormal pressure and they will also operate fairly cool due to the presence of water. On the other hand, they may contribute to high lubrication and production costs should they tend to drag or stick, for this will ultimately cause flat spots. Continued operation under such conditions will not only entail expense, due to roll replacement, but also it may seriously affect the quality and uniformity of the paper at its most formative stage for the drag will react on the drive, which is frequently accomplished through the lower couch roll.

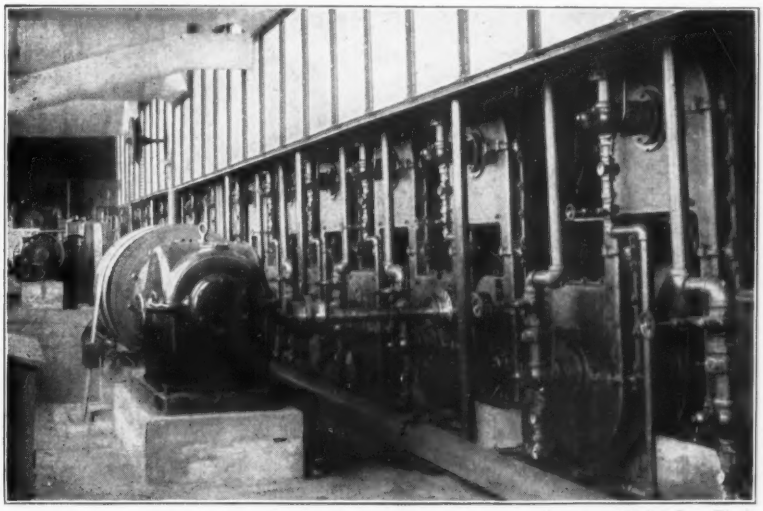
An automatic wick feed and reservoir oiling device will frequently be the solution of lubrication problems, for it will not only insure automatic readily controlled delivery of oil to such bearings, but also will largely eliminate the uncertainty due to the human element where individual lubrication is necessary. In fact, by use of a manifold and circulating system, the operator will be almost entirely relieved of the necessity to attend to such bearings, except where the oil reservoir is to be refilled or the wick stripped.

The use of a compounded oil will, of course, require stripping or cleaning of wicks at periodic intervals to prevent gumming, which would ultimately lead to impaired lubrication should the pores of the wicks become entirely clogged.



Courtesy of Downingtown Manufacturing Company

Fig. 8—A Downingtown board calendar. The top bearings of this installation are gun metal lined. The bottom bearings, however, are solid gun metal. Pressure is applied through screws by means of the hand wheel showing on the front side.



Courtesy of Beloit Iron Works

Fig. 7—A view of the drive side of the dryer section of a Beloit paper board machine showing method of driving, the steam joints and the relative location of the hypoid gear unit.

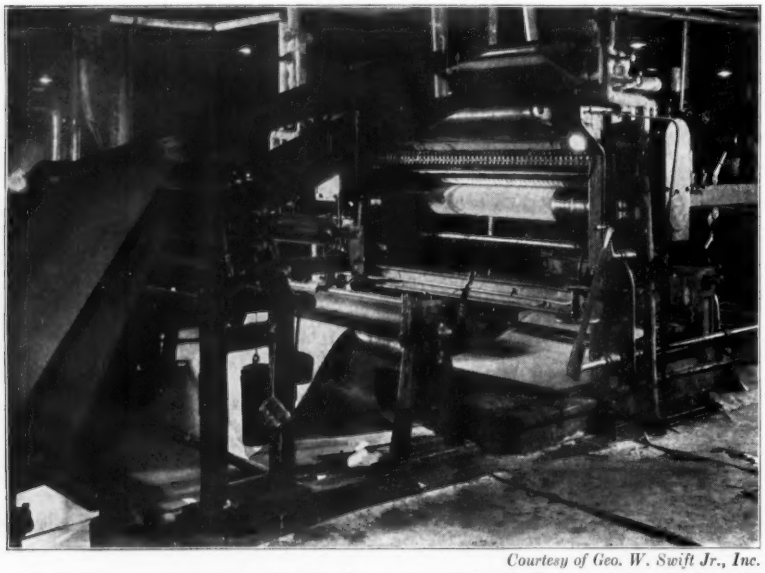
DRYING

The process of drying involves a continuation of the rolling action already begun on the wet end. At the dry end, however, the roll mechanisms consist of a series of hollow cast iron cylinders, heated internally by steam.

The dryer rolls are built to run in synchronism, being geared together in order to function in absolute unison with each other, thereby subjecting the sheet to virtually constant tension. This latter is passed to the first set of dryer rolls directly from the press rolls. The arrangement of the dryer rolls has a good deal to do with the finished surface of the paper.

The use of steam for heating and drying re-

quires carefully designed steam joints to prevent leakage; otherwise there may be the possibility of damage or staining of the product being handled, due to the oil content of the steam, especially where exhaust steam may be passed to open type feed water heaters and subsequently returned to the boilers without adequate removal of any cylinder oil which it may contain. Obviously the resultant live steam may carry over a certain amount of this oil to the dryer rolls, greatly reducing the efficiency of drying.



Courtesy of Geo. W. Swift Jr., Inc.

Fig. 9—Side view of a Swift Combination Corrugating and Double Facing machine, showing relative location of operating mechanisms and means of adjustment. Lubrication on certain of the exposed parts must, of course, be carefully carried out to prevent spotting or discoloration of the board.

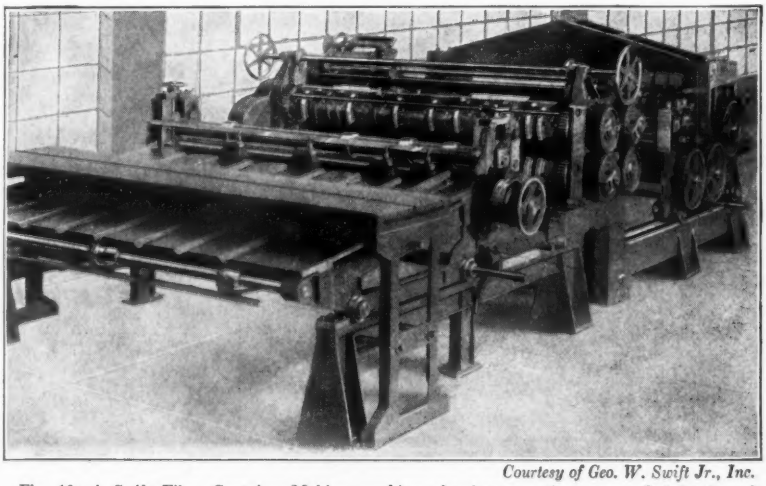
Steam joints should, therefore, be periodically checked to prevent excessive leakage; but they should never be screwed up so tightly as to cause wear. Steam joints can be adequately protected by cylinder oil or grease; the use of either, properly applied to the faces of the moving parts, will insure proper lubrication, the prevention of wear and consequently steam leakage. Steam joints present one of the greatest potential power consuming elements in the paper industry.

Lubrication

Relative to lubrication, one must be concerned with high temperature and pressure. Fortunately, speed is not much of a factor. On the other hand, inaccessibility must be given due consideration, for the bearings on the back or steam side are frequently almost impossible to reach, due to the driving gears.

The sleeve bearing is virtually standard on the dry end of the cylinder mould machine; oil lubrication also prevails. The wick feed oiler and waste pad have been found to be very dependable as a means of handling this oil, especially if the top bearing is built with a suitable recess or waste pad pocket. In such conditions the wick oiler will automatically deliver the requisite amount of oil to the pad to maintain dependable lubrication. By designing such systems so that the pad end of the wick is lower than the end immersed in the oil reservoir, the principles of both capillary and syphonic action are used to good advantage. Other types of such bearings may be designed for ring or collar oiling.

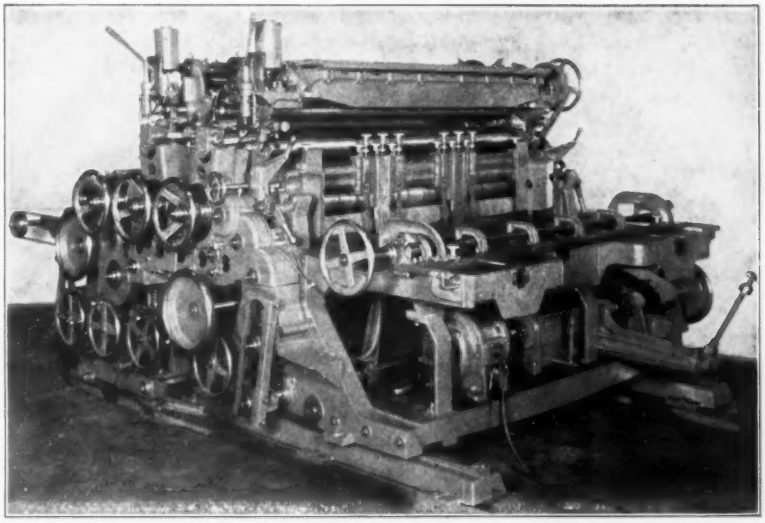
The use of the ring or collar oiler in conjunction with an automatic oil circulating system is particularly noteworthy, for circulation, if properly accomplished will insure against overheating, the flood of oil acting as a cooling or heat removing medium. Furthermore, means of filtration and cooling are frequently installed with such systems to give the added advantage of clean cool oil. There is also a decided ele-



Courtesy of Geo. W. Swift Jr., Inc.

Fig. 10—A Swift Fiber Container-Making machine, showing operating gears. Lubrication of these elements is always important in the interests of obtaining perfectly synchronized motion of the respective rolls.

ment of dependability involved, for in case there should be any interruption of oil flow due to breakdown of the circulating system, or should it have to be cut out temporarily for minor repair or adjustment, the capacity of the bearing reservoirs and the automatic action of the rings or collars in maintaining oil circulation will insure dependable and continued operation for a considerable length of time. If it is not practicable to install an extensive circulating system, however, somewhat the same results will be obtained by using an individual oiler in conjunction with each bearing as is sometimes done on the Fourdrinier.

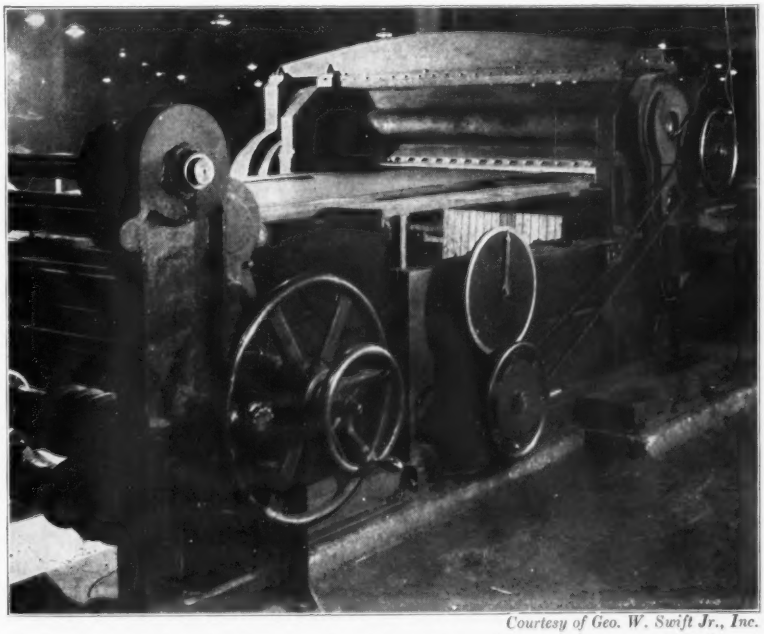


Courtesy of Bowen Products Corporation

Fig. 12—A box making machine of F. X. Hooper Company design equipped for automatic lubrication by positive application of measured amounts of oil at regular intervals to many of the most important bearings.

Back Drive Bearings

Lubrication of these bearings must be carefully attended to, for neglect may cause the rolls or cylinders to sag, which will in time necessitate undue expense for repair as well as loss of time during the period of shutdown.



Courtesy of Geo. W. Swift Jr., Inc.

Fig. 11—Another view of the Swift paper board Fabricating machine. Certain parts of this element must be provided with means for automatic lubrication to prevent wear and possibility of costly readjustments.

To meet the pressure and temperature conditions the oil used should normally be of comparatively heavy body, ranging from 60 to 170 seconds Saybolt at 210 degrees Fahr., according to the condition of the bearings, the means of application and the temperatures. Ease of distribution is important and might be regarded as the outstanding requirement. On the other hand, the more fluid the product the more readily will it vaporize when exposed to comparatively high temperatures.

Calender Stacks

From the dry end of the paper machine the paper passes to a calender stack for final finishing. This is virtually an ironing process, during which the sheet is passed through a series of rolls. These latter subject the paper to high pressure, at a speed commensurate with the nature of the desired finish. The average stack will have from three to eleven rolls of varying size, although in general the top and bottom rolls will be the largest.

The duty involved comprises both pressure and speed; consequently the bearings will present a decided problem of lubrication. This had led to adoption of circulating flood lubrication in connection with ring oilers. Flood of lubricant developed by leading oil under sufficient pressure and in adequate

volume to each respective bearing will effectively protect them from accumulation of non-lubricating matter by washing this latter out during circulation of the oil. To insure that the oil will be of sufficient purity for continuous usage, however, proper means of filtration is a further advantage. This will prevent accumulation of non-lubricating matter which might otherwise hinder free circulation of oil.

Such means of lubrication also brings about cooling. While steam heated rolls are not used throughout the entire calender, the pressures of operation and crowding frequently develop considerable temperature. To an extent this will be conducted to the bearings, or in low clearance elements, actually generated therein. By serving them with a flood of oil, however, lubrication as well as cooling is accomplished, the return oil carrying away a considerable amount of heat, which is subsequently dissipated in the filter and storage tanks prior to recirculation.

FORMATION OF PACKAGE CONTAINERS

After box or paper board is made on the paper machine, it is ready for formation into containers. One of the largest uses for this product in recent years has been as a substitute for wood in packaging of smaller containers of foodstuffs, canned goods and bottled products. It is durable, protective and of distinct advantage in that it eliminates the return problem, for the waste item is negligible when ultimately destroyed. Furthermore, the absence of nails removes a distinct personal hazard.

Formation of cartons or containers starts with large sheets up to about six feet square. These are delivered to a preliminary cutting machine where the necessary cuts are made according to the overall area of the finished carton. The ultimate size of this latter may control the original size of the board used. While it is still in the flat state, the necessary printing is done on a specially designed printing machine according to the nature of the product to be packaged. Quick drying is accomplished by using special inks and passing the boards from the printing machine through a drying oven.

The board sheets are then ready for slitting to enable formation of the bottom, sides and top of the carton. Slitting and creasing, whereby the actual package is formed, are carried out on the same machine, following which the packages pass automatically to a stitching and taping machine which permanently fastens the box together, leaving only the top sections free. These are sealed after the box is packed with whatever product it is intended to hold.

Any number of small bearings, gears and exposed chains present a set of conditions which require considerable care in the lubrication of box board machinery. It is of course highly essential that lubricants be prevented from splashing or dripping, otherwise the appearance of the product might easily be marred with oil spots. For this reason, automatic means of lubrication have been carefully studied and widely applied.

Pressure Grease Appliances

For many of the accessible bearings, pressure grease lubrication has been widely adopted. The unit or smaller type of pressure gun has proved to be especially adaptable to this work and readily controllable so that excessive lubrication can be avoided provided the gun is properly handled. The bearing must, however, be designed for this type of lubrication and capable of retaining its charge of lubricant. In this connection, grease can sometimes be effectively substituted for oil especially if the clearances of sleeve-type bearing are worn. Grease is also preferable for the smaller type of ball or roller bearings which may be applicable to certain parts of board handling machinery. It is especially advisable to study its applications to unit motor drives where bearings of this type are employed.

Pressure lubrication insures economical and positive delivery of the lubricant under adequate power to assure that a sufficient film of grease will be constantly maintained in the clearance space of the sleeve type bearing, or on all the moving parts of the ball or roller bearing. Labor for operation is also reduced and is rendered less hazardous; likewise, the possibility of entry of foreign matter is decreased. The pressure grease gun is also highly advantageous where a sleeve type bearing must be cleared of old grease.

Good judgment is necessary in deciding when a bearing has been completely cleared of old grease and re-filled with fresh product; otherwise waste will result and also a sloppy condition may develop around the machine which may be quite an objection. Furthermore, the ball or roller bearing should never be treated in this manner, otherwise the seals may be impaired, especially as this type of bearing is in general more compactly built than the conventional plain bearing and, therefore, better capable of resisting entry of foreign matter.

Pressure grease lubrication can, of course, also be obtained by means of the compression grease cup. Normally, however, this device will be more sensitive to handling by the machine operators, and there will be greater possibility for excessive use of lubricant and contamination of this latter, for periodically the

cover of the cup must be removed for filling, which is usually carried out right alongside of the machine itself. Furthermore, the capacity is usually limited, requiring quite frequent attention. There are distinct advantages, however, in that compression cups are low in first cost and simple to handle and install.

Centralized Oil Lubrication

The application of centralized pressure in connection with oil lubrication of certain of the parts of the board creasing, slitting and folding machine is an interesting extension of the principles of automatic lubrication. Where centralized pressure is employed, all moving parts are periodically flushed and supplied with fresh oil from a central reservoir. By locating this latter adjacent to the machine to be lubricated and within easy reach of the operator, and equipping it with a suitable plunger which operates the pump, lubrication of all parts connected thereto becomes but a matter of pressing a button, pulling the plunger or turning a wheel whenever required by the lubrication schedule. This latter must normally be worked out according to the operating conditions, the design of the bearings and the volume of oil each is capable of handling.

In such a lubrication system, the amount of oil delivered at each period of operation can be so accurately controlled according to the bearing requirements, that waste or leakage is reduced to a minimum and the maximum of lubricating value is obtained from the oil. The available pressure also makes it possible for the oil film to take up some of the operating pressures to further protect the bearings.

The fact that certain bearings will vary from others in regard to their requirements renders it necessary to provide for some arrangement of regulation or control of flow. Practically, this amounts to a metering of the lubricant in terms of drops. It can be brought about either by proper individual construction of the drip plugs, which on such equipment are also known as control outlets; by use of a control device located at the base of the pump, or by the installation of suitable adjusting manifolds at salient points in the system.

Properly installed, such systems are claimed to be relatively fool-proof, exceedingly simple to operate, and an insurance that clean oil will be delivered to the respective bearings. It is essential, however, that all parts be of rigid construction and capable of withstanding jars, shocks and temperature fluctuations, for while piping, etc., is guarded wherever practicable it is relatively impossible to protect all parts absolutely from the chance of contact with external materials.

It is interesting to note that the possibility of entry of dust into such a system is quite as negligible as in a pressure grease lubricator. Further, to insure that clean oil is used, a suitable filtering media, such as a felt pad or screen is employed, which will normally effectively remove any foreign matter that may have entered the oil in the course of storage or handling prior to usage; although lubricating oils as received from, or delivered by, reputable oil refiners can be relied upon as being free from foreign matter.

CHAINS AND GEARS

The extent to which gears and chains may be used on machinery incident to the manufacture or fabrication of paper board and containers will render it advisable to have a thorough understanding, particularly of the essentials of gear lubrication. There are certain definite properties which any lubricant should, in general, possess if it is to function effectively in such service. These are:

1. Sufficient lubricating ability to insure the reduction of both solid and fluid friction to a minimum.

2. Viscosity or body commensurate with the method of lubrication and the amount of heat that may be encountered, such that a suitable film will be insured between the teeth or chain links as they engage and the effects of both pressure and temperature resisted. Pressure, of course, exerts a squeezing out action; temperature renders a lubricant more or less fluid, according to its degree, for viscosity is reduced as temperature rises.

3. A sufficient degree of adhesiveness so that in event of use under exposed or semi-enclosed conditions a requisite film will remain on the teeth to resist the tendency of centrifugal force to throw it off.

4. As little tendency as possible to congeal, harden, crack or become brittle when used under lower temperature conditions; or, to carbonize and chip if exposed to abnormally high temperatures.

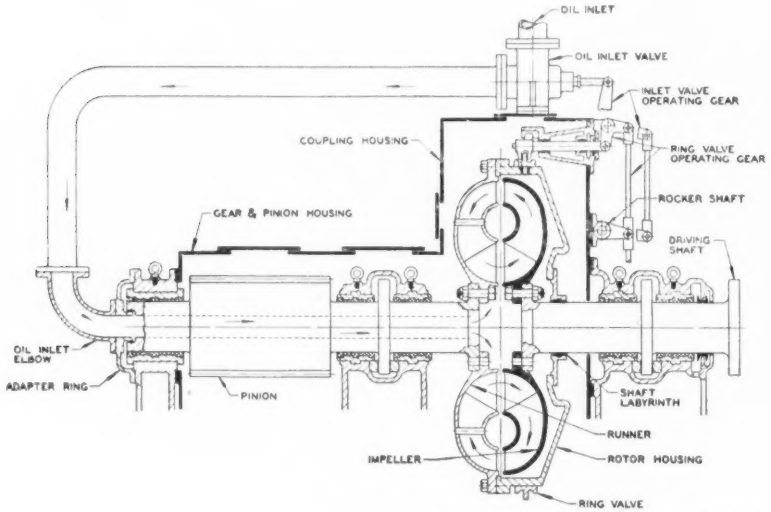
To reduce wear, noise, misalignment of parts, rusting, stripped teeth, vibration, etc., it is absolutely essential that the above requirements be given consideration. It is also important to study them from the viewpoint of their relative importance, depending, of course, on the design, mode of operation, whether or not automatic or bath lubrication is practicable, and the nature of the installation.

Pressure is of distinct importance in the study of gear lubrication. As a rule, tooth pressures will be high and the bearing surfaces, due to their relatively small areas of contact, will carry heavy loads.

Petroleum Lubricants in Hydraulic Coupling Operation

Flexibility in speed control and power transmission is of distinct importance in connection with the application of the unit motor drive to certain types of industrial machinery. The advantages incident to variable speed have consequently aroused considerable interest in the study of application of the principles of hydraulics to coupling design. The result has been that during the past few years the hydrokinetic or turbo type fluid coupling has come into prominence for use in various marine, industrial and traction applications.

This development is of primary concern to the petroleum industry due to the fact that straight mineral lubricating oil is applied to the coupling in varying quantity according to the speed ratio desired between the driving and driven members. There is an additional feature of interest in that no close clearances prevail between any of the moving parts, with the result that wear and potential lubricating problems incident thereto are claimed to be reduced to a minimum. The only point approaching actual contact between the coupling halves is the ball thrust bearing which is located between the driving and driven shafts. The traction coupling also takes the place of the usual friction clutch and flywheel. By thus providing a fluid connection between the driving and the driven machine, the transmission of shocks and tortional vibrations is eliminated. Where used for variable speed, this coupling combines the electrical advantages of constant speed induction or synchronous motors with the operating advantages of wide range stepless speed control.



Courtesy of Hydraulic Coupling Corporation

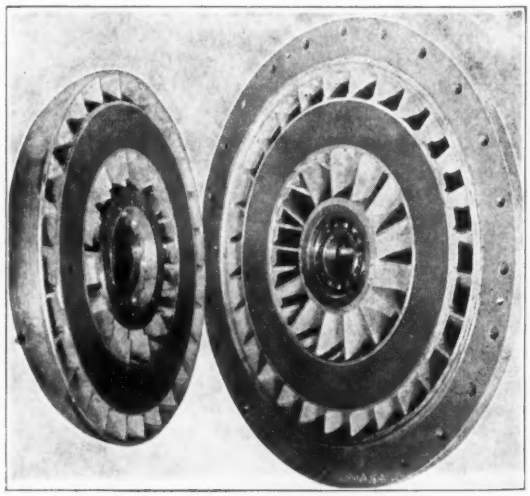
Fig. 1—Showing the type "K" Vulcan hydraulic coupling. Note the tie-up to the gear assembly.

In the hydro-kinetic coupling power is transmitted by the kinetic energy of a liquid discharged by an impeller on the primary shaft against the vanes of a turbine runner on the secondary shaft. Because of its lubricating qualities and availability, the liquid most commonly used is a straight mineral oil having a viscosity range of from 140 to 300 seconds Saybolt at 100 degrees Fahr., according to the type of operation.

There are three general types of hydraulic couplings, viz:

The Vulcan Marine Coupling
The Vulcan-Sinclair Variable Speed Coupling
The Vulcan-Sinclair Traction Coupling.

The Vulcan Marine Coupling in its most common form is shown in Fig. 1. The impeller shown on the right is attached to the driving shaft and the runner on the left is connected to the driven shaft. These two parts face each



Courtesy of Hydraulic Coupling Corporation

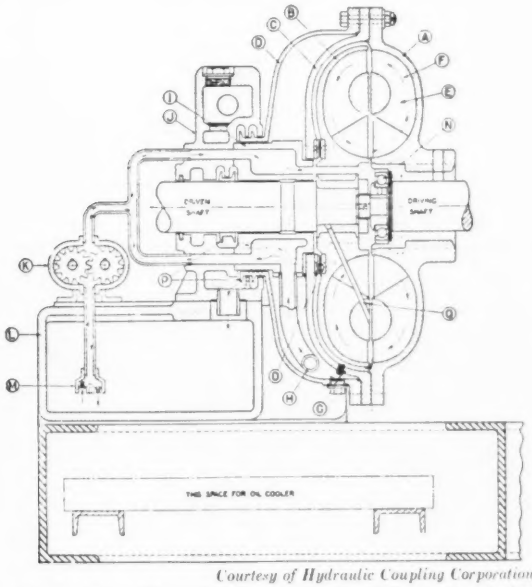
Fig. 2—The runner and impeller which go to make up the main rotating parts of a hydraulic coupling.

other but are not connected mechanically. Power is transmitted from the impeller to the runner by the circulation of fluid, impelled by centrifugal force, between radial passages formed in the two members.

The marine coupling makes possible the connection of a low speed propeller or dredge pump to a high speed Diesel engine through a mechanical reduction gear without the transmission of torsional vibrations or shocks. It also permits rapid clutching or declutching by simply removing or admitting fluid to the working circuit.

Vulcan-Sinclair Variable Speed Coupling: This is a more recent development of the hydraulic coupling and is used where it is desired to obtain wide range stepless speed control of a machine driven by a constant speed electric motor of the squirrel cage or synchronous type.

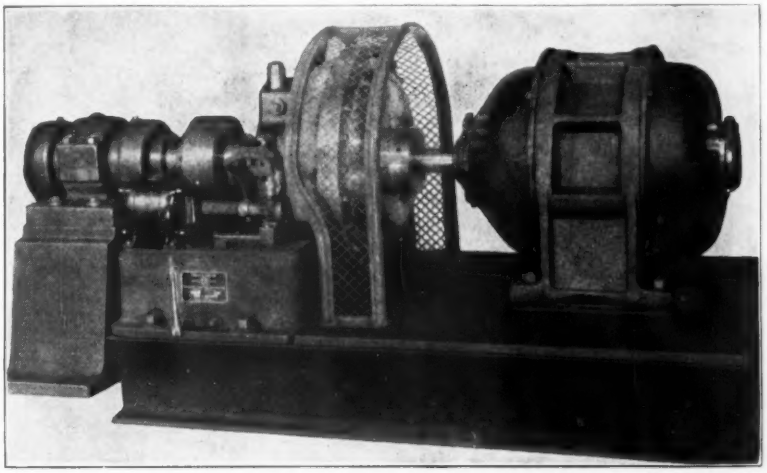
Accurate regulation of speed is obtained by varying the quantity of oil in the working circuit, several methods being employed for accomplishing this purpose.



Courtesy of Hydraulic Coupling Corporation

Fig. 3—A type VF coupling diagram showing oil flow as described in text.

This coupling is made up of two main parts which are known as the impeller and the runner. The impeller is keyed to the driving or motor shaft and the runner to the shaft of the machine to be driven. There is no mechanical connection between the two halves and, as stated above, power is transmitted by the kinetic energy of oil circulated between radial passages cored in the two members.



Courtesy of Hydraulic Coupling Corporation

Fig. 4—A typical variable speed hydraulic coupling installation indicating compactness of the entire assembly.

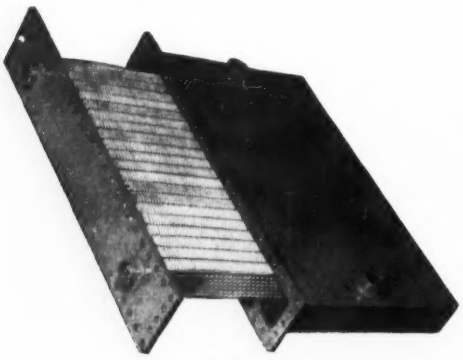
Fig. 2 illustrates the construction of the impeller and the runner, while Fig. 3 shows a cross section of a type "VF" coupling, the arrows indicating the flow of oil in the working circuit. Oil, impelled by centrifugal force, flows out through the radial passages in the impeller (A) and inward toward the shaft through the passages in the runner (B) thus taking the form of a vortex. The relative speed between the driving and driven members is regulated by varying the quantity of oil in the coupling.

Referring again to Fig. 3, it will be seen that a double casing (C) and (D) is bolted to and rotates with the impeller. Oil is leaked off continuously through calibrated ports (G) in the inner casing into the space between the inner and outer casings where it is picked up by a stationary scoop tube (H) which is supported by an external manifold (J).

In the type "VF" coupling the scoop tube discharges its oil directly back into the working circuit of the coupling through cored ports in the scoop tube housing (I) and the manifold (J). Speed variation is accomplished by removing or returning oil to the coupling by means of a small rotary pump (K) direct attached to a reversible motor. The pump operates only when a change of speed is desired. Oil removed from the coupling is stored in a tank (L) located immediately below the coupling manifold.

Where auxiliary oil cooling equipment is required it is usually installed in the base of the

coupling and consists of a welded steel casing enclosing an extended surface copper coil as illustrated in Fig. 5. Water is the cooling medium and about one gallon per minute is required for each 50 H.P. of motor rating in fan or pump service.



Courtesy of Hydraulic Coupling Corporation

Fig. 5—The oil cooling element referred to in the text.

Although the variable speed hydraulic coupling has been used principally for driving mechanical draft fans, many other applications have been made. Among these are boiler feed and condensate pumps, reciprocating compressors, tunnel and mine ventilating fans, turbo blowers, stokers, rotary kilns, conveyors, soap plodders, laundry ironing machinery, load equalizing flywheel generator sets, coal pulverizers, and jute sizing machines.

Many types of automatic regulation for the control of pressure, volume, torque and speed may be applied to the variable speed hydraulic coupling.

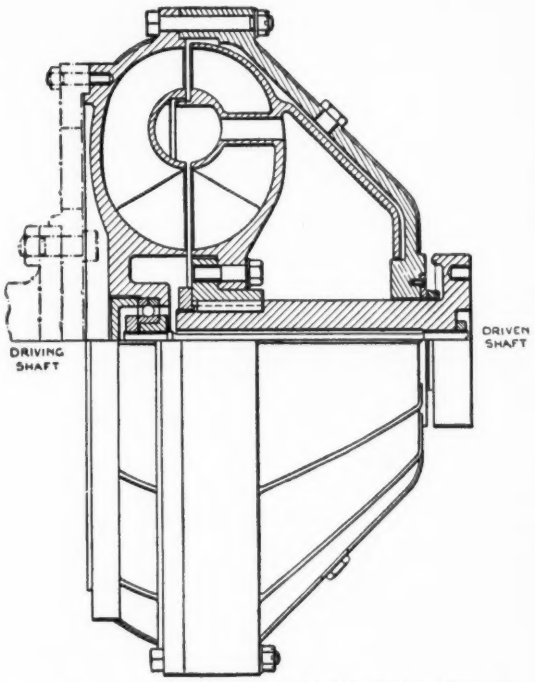
The Vulcan-Sinclair Traction Coupling: The coupling shown in Fig. 6 is a self-contained unit which has found wide usage in connection with internal combustion engine driven industrial locomotives, rail-cars, automobiles, power shovels, and portable compressor sets.

The traction coupling provides a smooth automatic take-up of the load, has no frictional wearing parts, prevents engine stalling, and eliminates the transmission of shocks and torsional vibrations. When used in connection with industrial locomotives, rail-cars, and automobiles where the coupling is located between the engine and the change-speed gear box, best results are secured when the transmission is of the constant mesh type.

An important feature of the traction coupling is the reservoir chamber provided on the back of the driven member which is connected with the working circuit by means of transfer tubes. The tubes permit an interchange of liquid from the working circuit to the reservoir and vice versa. The objects of the reservoir chamber may be enumerated as follows:

(1) To remove part of the oil from the working circuit under starting conditions; i.e., between 100 and 50 per cent slip so as to reduce the drag torque or creeping tendency, and to assist the engine in picking up the load more readily when the throttle is opened.

(2) To return the oil into the working circuit automatically when a certain speed is reached so as to reduce the slip to a very low value at normal speed.



Courtesy of Hydraulic Coupling Corporation

Fig. 6—A traction type coupling arranged to give lateral flexibility, thus permitting slight mal-alignment of driving and driven shafts.

(3) To act as an expansion chamber so that the pressure rise in the coupling is of a negligible order even if it is stalled at high torque and the temperatures are in excess of any met with in ordinary service.

(4) To separate air from the oil so that the working circuit is kept sufficiently charged with air-free oil while the air collects near the center of the reservoir chamber.

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